Material Having Characteristics of High Thermal Conductivity and Electromagnetic Interference Resistance

TECHNICAL FIELD

The present invention relates to a compound material, especially to a compound material having both the characteristics of super thermal conductivity and electromagnetic interference resistance in the meantime.

DESCRIPTION OF RELATED ARTS

Electronic or electrical devices, especially those running with high power, are inevitably confronted with the problem of thermal dissipation. The traditional method to solve this problem is to additionally equip themselves with a special means or device to dissipate heat occurred therefrom, for example, a forcible convection system consisted of one or more fan fins.

However, as far as those small or micro electronic elements such as a CPU, which are used in compression circumstances, for example, are mounted on printed circuit boards, it's far from enough to use said forcible convection system to solve the heat dissipation problem because no enough heat dissipation area can be available. Hence, at least a radiator like device with more fan fins and high thermal conductivity thereof should be added onto the heat dissipating surface of the CPU.

Commonly, said radiator like devices having several fan fins are made of a kind of metal material such as aluminum alloys which is rigid. But, when said devices are mounted onto the CPU, a small space will unavoidably be left therebetween which will allow air to be filled

therebetween. Since air is not a good heat conductor, the performance of the whole heat dissipation system will be adversely affected.

Hence, a new soft material with high thermal conductivity thereof is expected to be adopted between the CPU and the radiator like device so that no air space will be remained therebetween.

Furthermore, when the electronic elements work, special measures still have to be adopted to overcome the electromagnetic interference (EMI) problem which is brought to other surrounding electronic elements because of the running with high speed or under high power, otherwise the other electronic elements may not be able to work normally.

Therefore, devices, which can conduct heat well and help to resist EMI thereof, are on demand. Relevant prior arts can refer to a Chinese patent ZL91101947.2 issued on March 15th, 2000. This patent discloses an EMI shielding device used on printed circuit board (PCB), which is essentially a shell made of thermal conducting materials. However, the shell can only perform its anti EMI and heat dissipation functions when it is connected to a grounding means set on the PCB. As a result, corresponding additional circuitries shall be pre-set on the PCB, which not only complicate the according circuit design, but also occupy the very limited space of the PCB.

So, people then turn to pursue other possible resolutions such as trying to find a special material which has both the characteristics of high thermal conductivity and EMI resistance. Taiwan patent TW345667 gives a compound magnetic material with high thermal conductivity. This material is produced by dispersing some soft magnetic powder and some thermal conductive powder into an organic bonding material. As the total

amount of the soft magnetic powder and thermal conductive powder which is allowed in the organic bonding material is limited, the according performance of both heat conduct and EMI resistance is not as good as expected.

Another prior art is to adopt a resin as the base material and disperse Al_2O_3 powder and silicone powder into the resin base. Although the resulted material is soft and has good heat conductivity, it can not be used to shield EMI.

In addition, there is a kind of electromagnetic wave absorbing material which is formed by adding some soft magnetic powder into a plastic base material. Since this wave absorbing material only can perform a good EMI shielding function while is a poor heat conductive material, the conventional application of this material for a CPU usage is to firstly form a hollow body in rectangular or columned shape and to attach the hollow body onto the CPU together with a few heat dissipating fins positioned in the hollow part of the hollow body. In order to gain better performance, additional heat dissipating fins or a small fan can also be attached onto the fins in the hollow body. Such measures can increase heat conducting effects thereof, however, it will decrease the electromagnetic wave absorbing effects thereof.

SUMMARY OF THE INVENTION

A main object of the present invention is to provide a compound material having both the characteristics of high thermal conductivity and EMI resistance.

In order to achieve the objects set forth, a compound material with

both the characteristics of high thermal conductivity and EMI resistance comprises a first high heat conductive layer and a first EMI shielding layer.

The compound material in accordance with the present invention further comprises a few alternately superposed high heat conductive layers and EMI shielding layers. The amount of the high heat conductive layers and EMI shielding layers can be determined according to actual requirements and the thickness of each layer can also be determined by according actual needs thereof.

The first high heat conductive layer and the first EMI shielding layer is superposed together. The first EMI shielding layer is tessellated and comprises a high heat conductive sub-layer. The EMI shielding material is filled separately and alternately in the sub-layer thereby forming a plurality of EMI shielding blocks of the first EMI shielding layer. The EMI shielding material is a kind of material which can absorb electromagnetic waves, and can be integrated with the sub-layer by planography printing or insert-molding methods.

The compound material in accordance with the present invention further has a second high heat conductive layer. The second heat conductive layer is superposed on one side of the first EMI shielding layer opposite to the first high heat conductive layer. A second EMI shielding layer is superposed on one side of the second high heat conductive layer opposite to the first EMI shielding layer. The structure of the second EMI shielding layer is similar to the first EMI shielding layer, but the positions of the EMI shielding blocks in the second EMI shielding layer are staggered relative to the positions of the EMI shielding

blocks in the first EMI shielding layer in the overlapping or vertical direction thereof.

The present invention adopts a design of alternately overlapped high heat conductive layers and EMI shielding layers. Each EMI shielding layer has a high heat conductive sub-layer in which according EMI shielding material is filled separately and alternately thereby forming a plurality of EMI shielding blocks, which makes each EMI shielding layer look tessellated and form a plurality of pre-set comparted portions (i.e., the EMI shielding blocks).

Furthermore, the positions of the EMI shielding blocks in different EMI shielding layers are staggered relative to the positions of the EMI shielding blocks in the first EMI shielding layer in the overlapping or vertical direction. Therefore, the accordingly staggered heat conductive portions of the high heat conductive sub-layers of the EMI shielding layers and the overlapped heat conductive layers can form a heat conducting track which is staggered, consecutive and sinuous, which can guarantee the high thermal conductivity of the compound material in accordance with the present invention.

In the meantime, since each EMI shielding layer has tessellatedly distributed EMI shielding material blocks and the EMI shielding blocks of different EMI shielding layers are staggered from each other in the overlapping direction thereof, a complete electromagnetic waves absorbing net is thus formed, which can ensure the super EMI shielding performance of the compound material in accordance with the present invention.

In addition, the compound material in accordance with the present

invention can be made into various shapes as desired, and then positioned onto correspondent electronic elements or devices. Hence, no additional circuitry design is needed with the application of the present invention which results in advantages of easy use and reliability, etc.

Other objects, advantages and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional sketch view of the compound material in accordance with the present invention; and

Fig. 2 is a plan sketch view of an EMI shielding layer of the compound material in accordance with the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring to Figs. 1 and 2, a compound material having the characteristics of high thermal conductivity and electromagnetic interference (EMI) resistance of the present invention is shown.

Fig.1 shows a sectional sketch view of the compound material. The compound material comprises a first high heat conductive layer 1, a first EMI shielding layer 2, a second high heat conductive layer 3, a second EMI shielding layer 4 and a third high heat conductive layer 5.

The amounts of the heat conductive layers (1, 3, 5) and the EMI shielding layers (2, 4) can be adjusted according to actual requirements. The thickness of each heat conductive layer (1, 3, 5) or each EMI

shielding layer (2, 4) can be pre-set according to actual application environments.

The second heat conductive layer 3 is superposed over one side of the first EMI shielding layer 2, which is opposite to the first heat conductive layer 1. The second EMI shielding layer 4 is overlapped over one side of the second heat conductive layer 3 in a way just like the way the second heat conductive layer 3 overlapped onto the first EMI shielding layer 2, and the position of the second EMI shielding layer 4 is opposite to the first EMI shielding layer 2.

The structures of the first and second EMI shielding layers 2 and 4 are both tessellated and each includes a high heat conductive sub-layer 23 or 43. EMI shielding material is separately and alternately filled into the heat conducting sub-layer 23 so as to form corresponding EMI shielding blocks 22, 42 which are alternately separated so that the arrangement of each EMI shielding layer 2, 4, or other added ones as required, looks like a chess board or is a tessellation.

The structure of the second EMI shielding layer 4 is similar to the first EMI shielding layer 2, but the positions of the EMI shielding blocks 42 of the second EMI shielding layer 4 are staggered relative to the positions of the EMI shielding blocks 22 in the first EMI shielding layer 2 in the overlapping or vertical direction thereof.

The EMI shielding material forming the EMI shielding blocks 22 and 42 of the first and second EMI shielding layers 2 and 4 is a kind of electromagnetic waves absorbing material. The arrangements of EMI shielding blocks 22 and 42 of the first and second EMI shielding layers 2 and 4 are tessellated in the according heat conducting sub-layers 23 and

43. The EMI shielding material of the EMI shielding blocks 22 and 42 can be integrated with the sub-layers 23 and 43 by planography printing or insert-molding methods.

The compound material in accordance with the present invention can further comprise more EMI shield layers and high heat conductive layers which are alternately overlapped over each other and the structures or compositions thereof are similar to the first and second EMI shielding layers 2, 4 and the first and second heat conductive layers 1, 3.

In the meantime, the EMI shielding blocks of each of the EMI shielding layers are all staggered from correspondent EMI shielding blocks of the EMI shielding layer which is positioned adjacent to it in the overlapping or vertical direction thereof, just like the way of the staggered arrangement of the first and second EMI shielding layers 2 and 4. Therefore, a complete electromagnetic waves absorbing net is thus formed which can ensure the super EMI shielding performance of the compound material in accordance with the present invention.

Moreover, the accordingly staggered heat conductive portions of the high heat conductive sub-layers 23 and 43 of the first and second EMI shielding layers 2, 4 and the overlapped heat conductive layers 1, 3, 5 can form a heat conducting track which is staggered, consecutive and sinuous, which can guarantee the high thermal conductivity of the compound material in accordance with the present invention.

The process of making the compound material of the present invention is simply explained below.

Step 1: take a suitable high temperature thermoplastic material with good thermal resistance, such as SiC, as a base material, and then

infiltrate Al_2O_3 powder into the thermoplastic material base thereby forming a first high heat conductive layer 1;

Step 2: form a high heat conductive sub-layer 23 with tessellated slots or holes therein over the first high heat conductive layer 1, the slots or holes are arranged separately and alternately;

Step 3: fill EMI shielding material into the slots or holes of the heat conductive sub-layer 23 thereby forming correspondent EMI shielding blocks 22 which are tessellated the same as those of the slots or holes of the heat conductive sub-layer 23, and thus the first EMI shielding layer 2 is formed;

Step 4: overlapped on the first EMI shielding layer 2, the second high heat conductive layer 3 is formed by infiltrating powder into a high temperature thermoplastic material base;

Step 5: form a high heat conductive sub-layer 43 with tessellated slots or holes therein over the second high heat conducting layer 3, the slots or holes are arranged separately and alternately;

Step 6: fill EMI shielding material into the slots or holes of the heat conducting sub-layer 43 thereby forming correspondent EMI shielding blocks 42 which are tessellated the same as those of the slots or holes of the heat conductive sub-layer 43, and thus the first EMI shielding layer 4 is formed, and the EMI shielding blocks 42 are staggered from the EMI shielding blocks 22 of the first EMI shielding layer 2 in the overlapping or vertical direction thereof;

Step 7: overlapped on the second EMI shielding layer 4, the third high heat conducting layer 5 is formed by infiltrating Al_2O_3 powder into a high temperature thermoplastic material base;

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After repeat the similar steps as above-described, the compound material in accordance with the present invention can be made to comprise a few alternately overlapped and integrated EMI shielding layers (2, 4) and high thermal conductive layers (1, 3, 5).

The present invention adopts a design of alternately overlapped high heat conductive layers (1, 3, 5) and EMI shielding layers (2, 4). Each EMI shielding layer has a high heat conductive sub-layer in which according EMI shielding material is filled separately and alternately, which makes each EMI shielding layer look tessellated.

Furthermore, the positions of the EMI shielding blocks in different EMI shielding layers are staggered relative to the positions of the EMI shielding blocks in the adjacent EMI shielding layers in the overlapping or vertical direction. Therefore, the accordingly staggered heat conductive portions of the high heat conductive sub-layers of the EMI shielding layers and the overlapped heat conductive layers can form a heat conducting track which is staggered, consecutive and sinuous, which can guarantee the high thermal conductivity of the compound material in accordance with the present invention.

In the meantime, since each EMI shielding layer has tessellatedly distributed EMI shielding material blocks and the EMI shielding material blocks of different EMI shielding layers are staggered from each other in the overlapping direction thereof, a complete electromagnetic waves absorbing net is thus formed, which can ensure the super EMI shielding performance of the compound material in accordance with the present invention.

In addition, the compound material in accordance with the present invention can be made into various shapes as desired, and then positioned onto correspondent electronic elements or devices. Hence, no additional circuitry design is needed with the application of the present invention which results in advantages of easy use and reliability, etc.

It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.